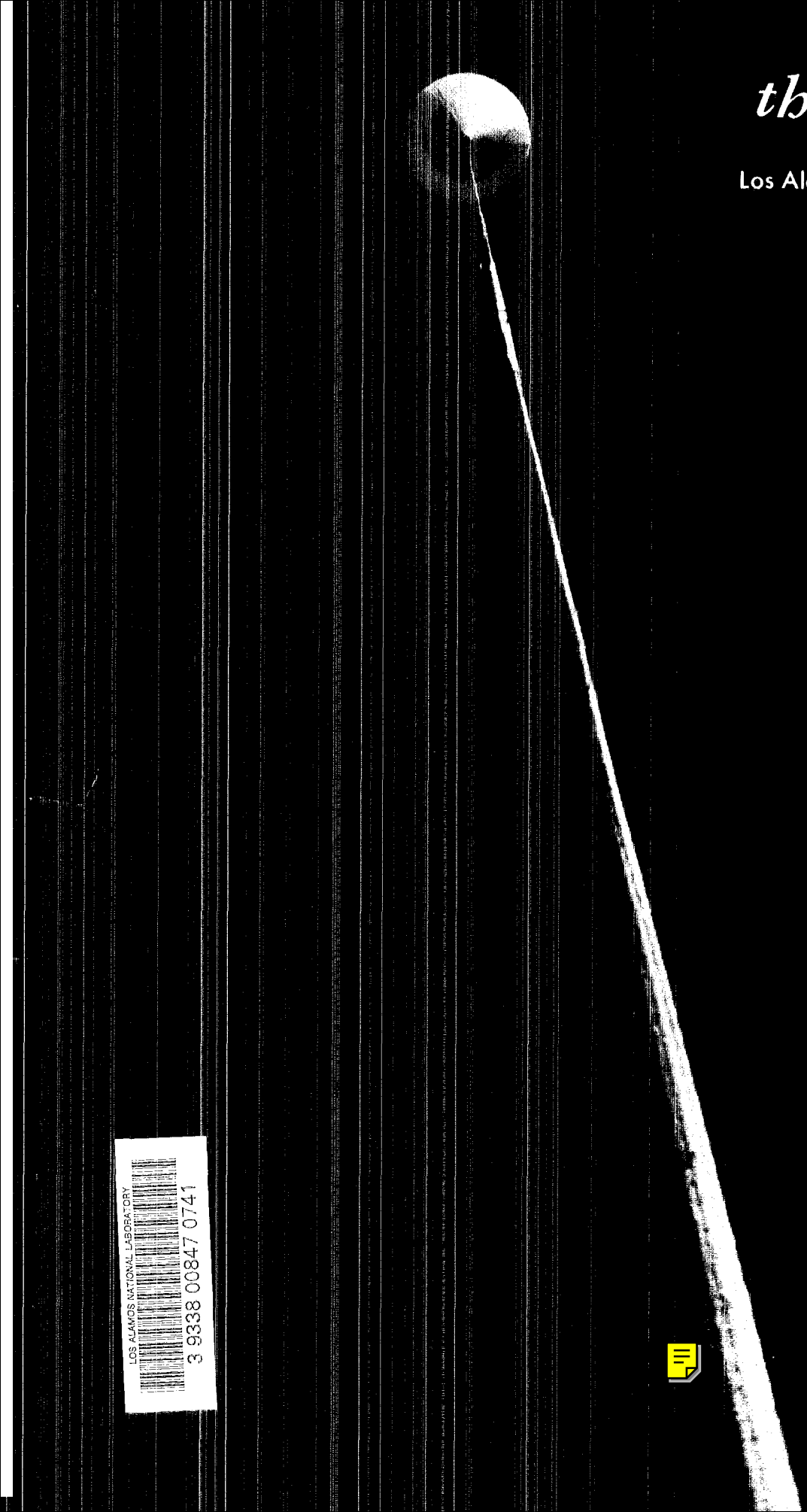
the Atom

Los Alamos Scientific Laboratory

December 1977



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In this Issue

Regular Features

Editor

John Armistead

Photography

Bill Jack Rodgers, Johnnie Martınez

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FRONT COVER

Bill Jack Rodgers took the front cover photo as he was practically wrapped around a rope, and tied to the top of the rope is a helium-filled balloon 800 feet above the floor of Ancho Canyon. More photos and a story are on page 18.

LASL's Geothermal Project Gets Steam

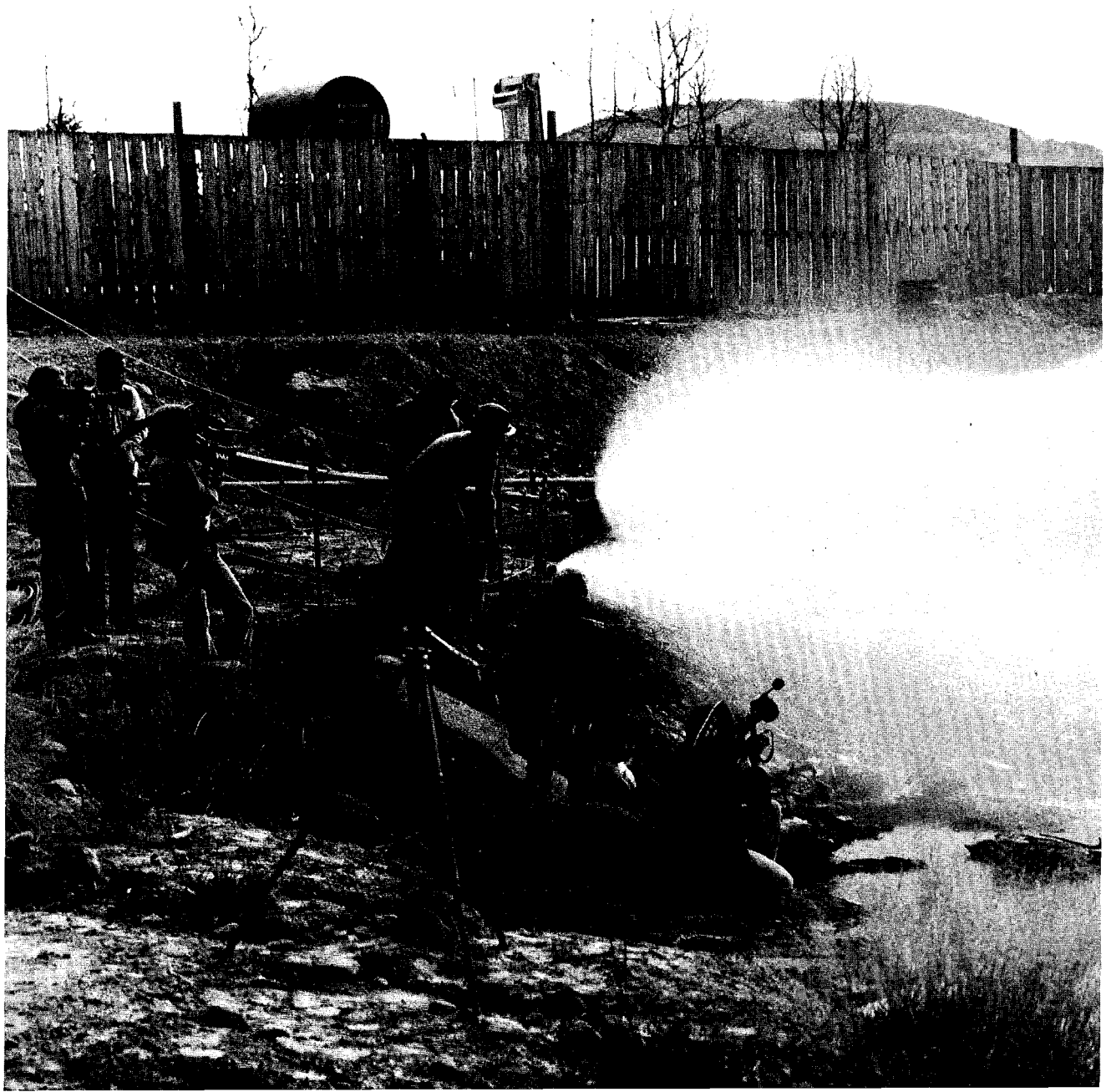
By Barb Mulkin

Late next summer, LASL's Fenton Hill geothermal drilling site may be partially self-powered with electricity produced by heat from the nation's first man-made geothermal reservoir. If that happens, and researchers are confident that it will, another first will be logged in a long list of accomplishments marked by determination and consumate skill.

Plans are to divert some of the superheated water from the geothermal reservoir, which became a closed-loop system in September, 1977, to generate electricity to feed back into the commercial power system operated in the area by Jemez Electric Cooperative.

Greg Nunz, alternate project manager of the Laboratory's Hot Dry Rock Geothermal Energy Program, says, "Essentially, what we hope to do is to produce about 60 kilowatts of electricty—not totally sufficient for our needs at the site, but enough to take the pressure off a substation of marginal capacity

Television news people and LASL film makers record the flow of steam at LASL's hot dry rock geothermal project in the Jemez Mountains. The steam was the last to be vented before a closed loop system was implemented.



and significantly reduce our utility bill."

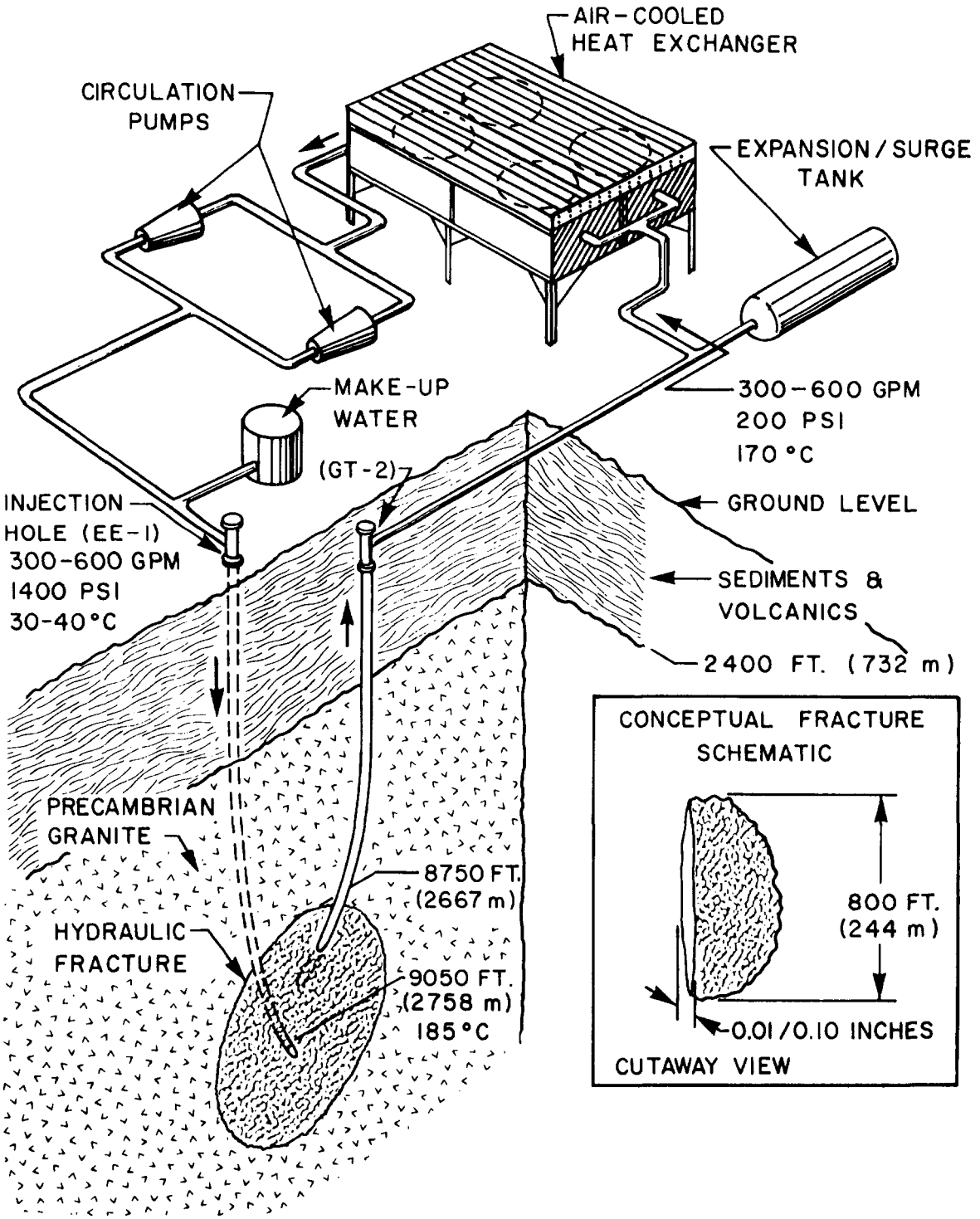
It is presently planned to test at least 2 generating systems at the site—one, a closed organic Rankin (binary cycle) system, and the other a helical screw expander generator that was originally developed for use with natural hydrothermal systems. These portable units will be tested consecutively while the planned series of closed-loop experiments scheduled for the reservoir itself is conducted during the next 12 to 14 months.

If geosciences researchers are forging ahead in a state of euphoria it is not surprising, for the success of the LASL geothermal program has been accomplished against seemingly overwhelming odds.

In 1970, during a study of a new drilling technique potentially useful for penetrating very hot rock, the LASL concept of extracting heat from large, dry geothermal reservoirs by duplicating the natural process in hydrothermal systems was formulated. LASL's idea basically involves drilling 2 holes into hot rock, connecting them at depth through a very large crack produced by hydraulic fracturing, and then circulating pressurized water through this connected system to recover heat from the rock. It is predicated on tapping the enor-

An aerial view of LASL's geothermal site and closed loop system at Fenton Hill shows the remoteness and compactness of the project.

LASL HOT DRY ROCK GEOTHERMAL CONCEPT
FENTON HILL HEAT EXTRACTION LOOP SCHEMATIC
10-20 MW (THERMAL)



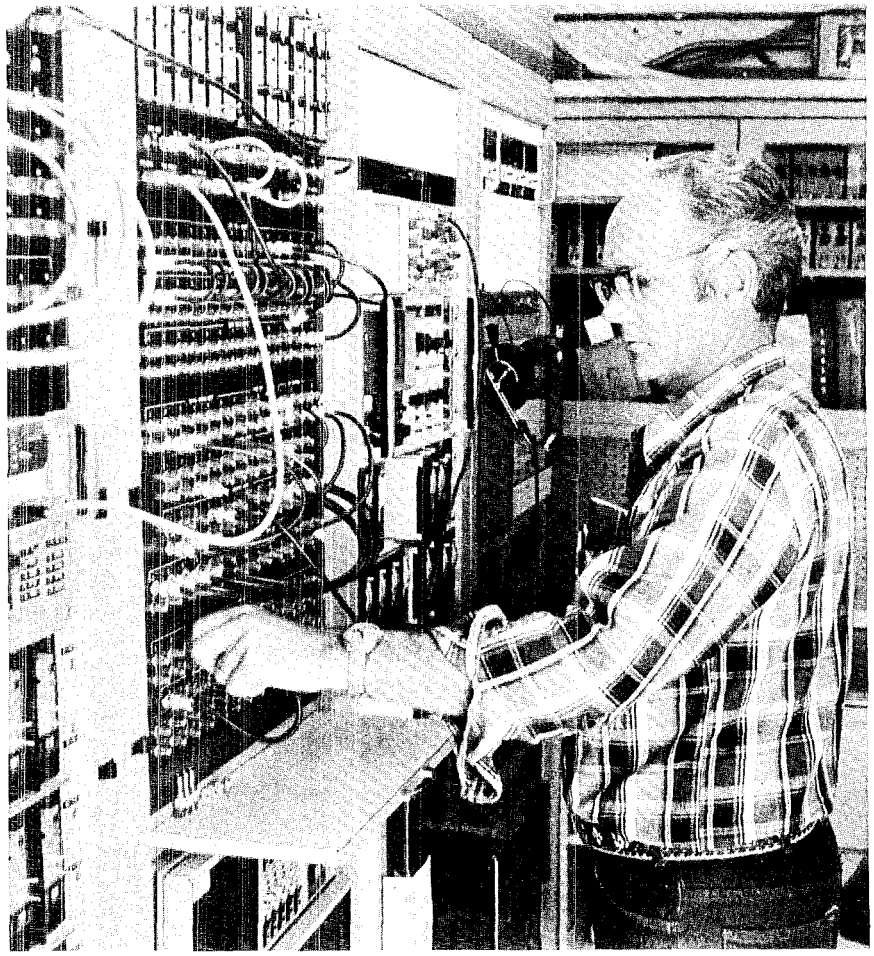
mous reservoir of energy in hot rock beneath the earth's crust by creating an environmentally acceptable extraction system.

The concept sounds deceptively simple, and, in fact, the Laboratory's prototype reservoir is working. But, to leave it at that is to overlook a series of major technical achievements.

Since 1970, LASL scientists have:

Successfully drilled into 200°C granite at a depth of 3 kilometers, and directionally drilled at this depth; produced fractures with radii as large as 150 meters in crystalline rock; established connections between 2 bore holes; recovered up to 95 per cent of the water injected into the system; developed instrumentation for a variety of downhole experiments capable of operating for long periods at high temperature and high pressures; developed fracture and borehole mapping techniques and equipment; demonstrated the reliability of geothermal power-production system model basing the total capital investment for a power plant on the costs of production, reinjection wells, and major equipment.

In addition, in June this year, after 20 hours of pumping, researchers induced a flow of superheated water that flashed to steam at the surface before being diverted to a holding pond. Late in September they successfully connected the reservoir to a pair of 10-megawatt-thermal heat exchangers, which are now extracting heat from the water before it is reinjected into the well.



Everett Holmes, G-4, inspects seismic metering equipment at the Fenton Hill geothermal project site.

Things are going well for the geothermal energy proponents, who have sometimes viewed themselves as stepchildren in the family of alternate energy resources. Related programs are flourishing, drawing on LASL's painstakingly acquired geothermal expertise.

Bill Laughlin, G-6 associate group leader, heads a program dedicated to assessing the geothermal energy potential of half a dozen sites around the nation, working with the United States Geological Survey and with several universities.

Much of the work will include identifying, or planning the extension of natural hot dry rock geothermal areas, using technology developed at LASL.

Areas to be surveyed include the Snake River Plains in Idaho west of Yellowstone Park; Mount Hood, Oregon; Roosevelt-Cove Fort, Utah; and the Coso Hot Springs, California area near China Lake.

In what Laughlin and Jim Maxwell, G-6, describe as a "broad-brush approach within the confines of time and money," studies are continuing, with Virginia Polytechnical Institute, on assessment of geothermal potential involving "hot spots"—areas where thick blankets of sediment have trapped heat produced by concentrations of uranium or thorium in granitic rock, primarily in the eastern United States.

Other research will include the feasibility of using hot water in Hot Springs, Arkansas, for direct space heating of buildings. The headquarters of the National Park Service near that city uses this method of heating. A study to assess the hydrothermal potential of the huge Madison aquifer in the North

Central plains states, coordinated with a hydrological study by the USGS is also under way. Results of this study are given to Johns Hopkins University personnel, who are planning the development of these resources.

Closer to home, G-6 staffers will act as managers and advisors to New Mexico and Arizona agencies in assessing the potential low temperature (90°C) hydrothermal systems that can be developed near populated areas in both states.

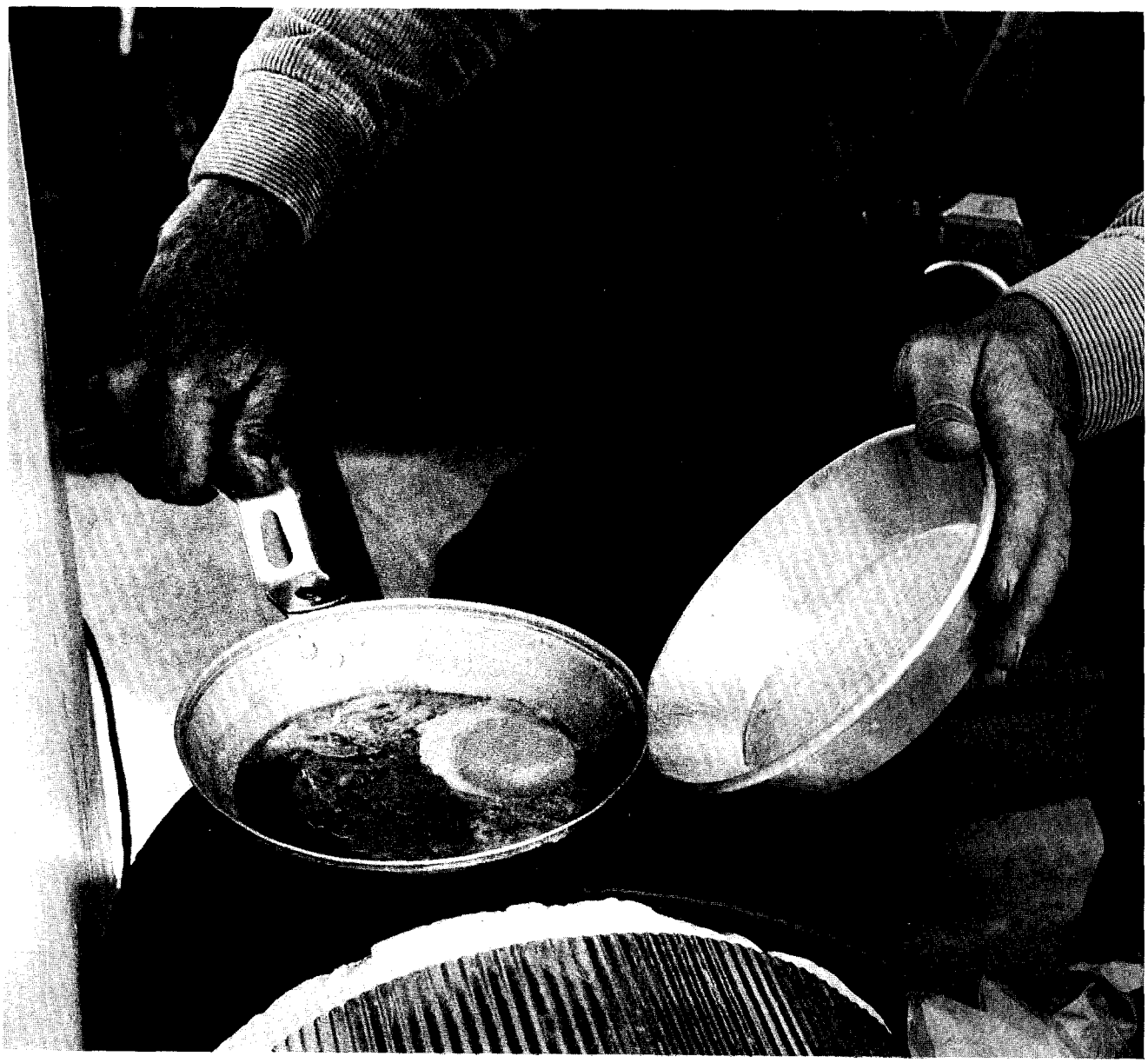
LASL will also manage a program charged with developing, in collaboration with industry, new techniques for geothermal reservoir characterization and geophysical logging in deeper, hotter holes than those on Fenton Hill and in types of rock other than granite.

Jim Hill, G-4, Fenton Hill test site manager, and Bert Dennis, G-4 group leader, feel LASL has already functioned, out of necessity, as an ad hoc laboratory for such a program.

They agree that the Los Alamos geothermal program, which started on a shoe string, has become adept at repairing, adapting, and fabricating necessary equipment, because much of the technology and the equipment needed as the program expanded simply did not exist.

Although the LASL concept is based on modified oil and gas field

Frying eggs on pipes heated by steam flowing through the closed-loop system may not be practical, but for photographer Bill Jack Rodgers it provided a diversion from the other picture-taking duties at hand.



drilling and hydrofracturing techniques, Hill and Dennis point out that the unique requirements of the hot dry rock extraction method led to constant improvisation.

Oil and gas exploration rarely penetrates deeper than the earth's sedimentary layer, which is easier to drill and not nearly so hot as the underlying basement rock. Hard rock and extreme heat were major restraints for the Fenton Hill researchers.

In addition, oil and gas reservoir crack systems need not be accurately mapped, but defining the dimensions and orientation of the LASL reservoir was critical, if it was to be tapped by the second bore hole for optimum water flow. Reliable logging and mapping instrumentation that would function at extremely high temperatures and pressures was not available.

Most of the vertical drilling at Fenton Hill was accomplished with conventional rotary bits powered from the surface. To achieve directional drilling, researchers switched to a Dyna-Drill system, which is powered downhole—a first for industry in hot granite. Fiscal '78 and '79 funding includes money for development, with a commercial contractor, of equipment capable of drilling to even greater depths at higher temperatures.

Jim Albright and Bob Potter, G-3, headed a team that devised the necessary mapping techniques for the Fenton Hill system. Several methods were tried, with the most successful proving to be an acoustic system that provided a "sound picture" of the underground system by measuring compression and shear waves, generated by small high-temperature detonators in one hole, as they were received by geophones in the second hole. Instrumentation was developed by Billy Todd and Jake Archuleta, G-4.

A second G-4 team, headed by Bob Hendron, designed the instrumentation for the closed-loop system that became operative in September. Equipment for the loop was fabricated by a group headed by G-4's Everett Horton.

Before the loop was closed, photographers had a field day, recording for posterity a fine display of live steam from the nation's first man-made geothermal reservoir. Even the most cynical seemed ready to concede that geothermal energy is a practical alternative energy resource, deserving even to be classed as an "inexhaustible" resource.

Of this, Al Blair, alternate G-Division head says:

"It is estimated that there are 13 million quads of thermal energy in dry rock at a temperature above 150°C at a depth of 10 kilometers or less beneath the continental United States."

"No One Source Can Provide An Easy Answer To The Energy Problem"

A quad equals a million billion Btus (British thermal units) of energy; U. S. energy consumption is 70 to 80 quads per year.

Experts estimate that just 2 per cent of those recoverable 13 million quads of energy would supply all of the nontransportation needs of the nation for 1,300 years, based on today's consumption rates.

But Blair is quick to add that much needs to be done in the geothermal energy field.

In the next 12 months, the Fenton Hill system will be evaluated to answer questions relating to reservoir life, water loss, and the interaction of the circulating fluid with the hot rock. Operation of the small 10-megawatt-thermal heat exchangers should identify many of the problems expected to surface in geothermal systems, allowing researchers to solve them before larger systems are designed.

The evaluation will overlap resumption of drilling during FY '79. Blair says that although LASL would like to drill 2 holes and create a second reservoir while operating the first, most likely, one of the existing holes will be deepened to about 4 kilometers in granite at 250°C, and another hole will be drilled nearby to intersect a planned new crack system in the deepened bore.

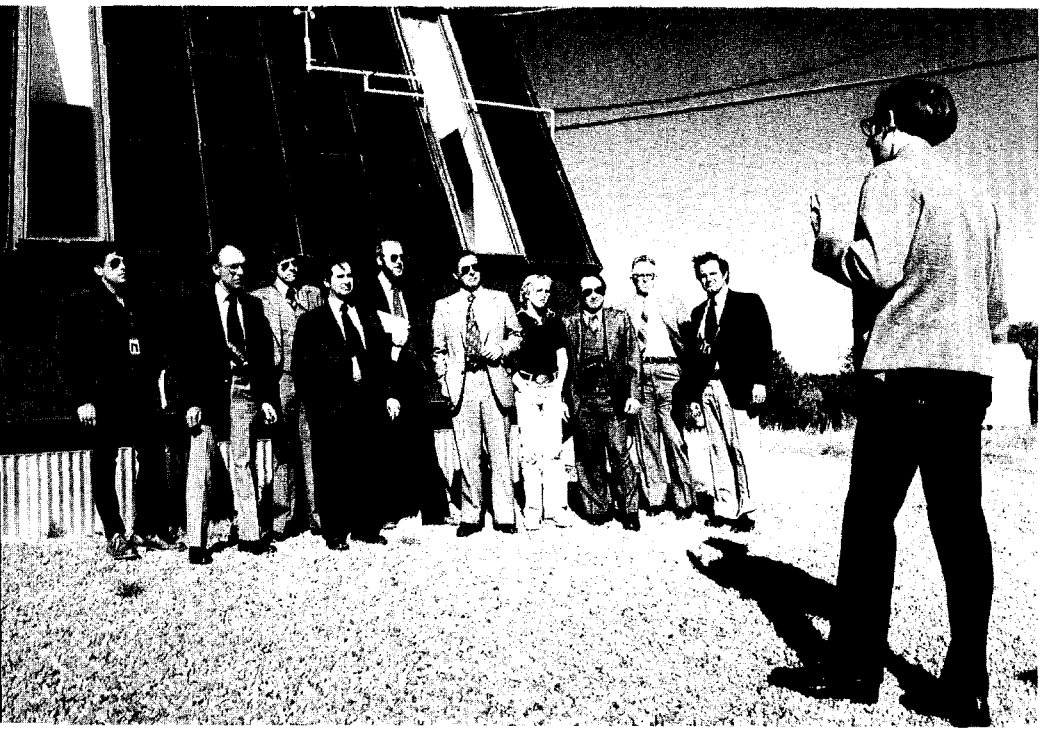
The resulting reservoir should have a capacity equivalent to 5 to 10 megawatts electric—sufficient for the needs of a city of 10,000. Blair points out that although LASL is not in the commercial electrical generating business, the Laboratory does plan to conduct a larger power-generation experiment at the Fenton Hill site in conjunction with the local utility company.

Another aspect of power generation in which LASL may become involved concerns heat for the Laboratory's main technical area.

A committee is studying the feasibility of using LASL geothermal technology to supply heat for TA-3, possibly using the existing steam heat supply grid and tapping 1 or more geothermal wells to be constructed at the site. Although no funds have been formally appropriated for this project, researchers do not discount the possibility of "going geothermal in this particular area."

If Los Alamos, the Atomic City, should one day be heated and lit by geothermal energy it may strike some as ironic. But perhaps the one truism to emerge from the endless debate over this country's energy future is that no one source, inexhaustible or otherwise, can provide a total, or easy answer to our escalating crisis. Energy is where you find it, and for LASL's geothermal believers the future looks good, looking down.

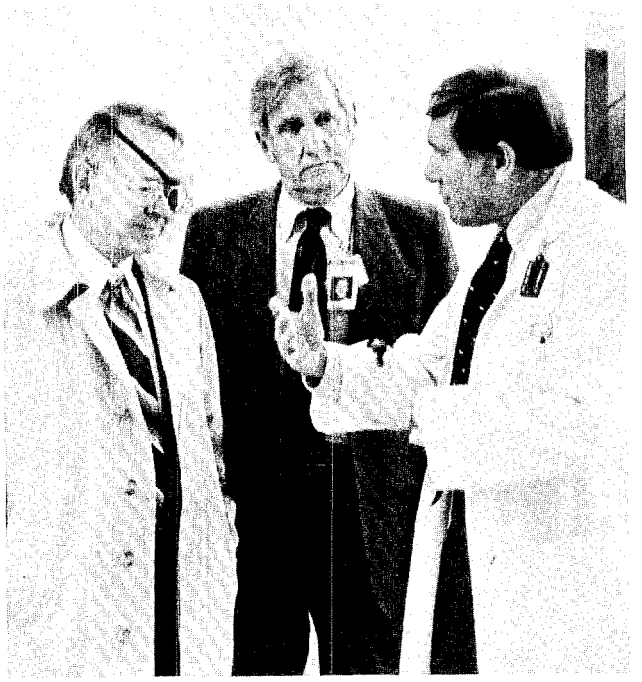
Among Our Guests

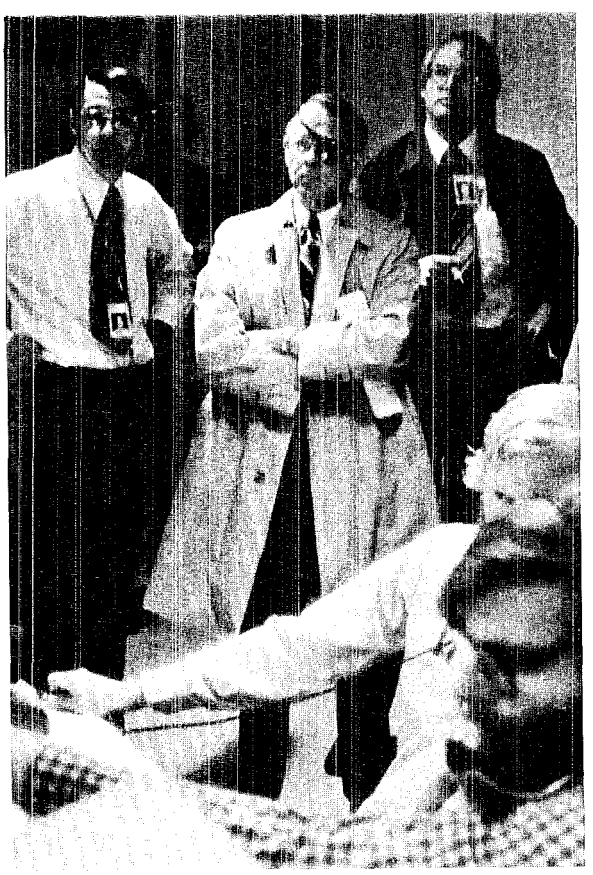


Officials of the Georgia Power Company and Public Service Company of New Mexico visited LASL recently for briefings on the Laboratory's various energy programs. Explaining LASL solar projects to the group is Chuck Bankston, Q-11.

LASL Director Harold Agnew talks with members of the University of California Science Advisory Committee during the group's visit here in November. The committee periodically visits LASL and Lawrence Livermore Laboratory in California and is available on a continuing basis to advise both the president of the University of California and the directors of LASL and LLL on science research programs at the laboratories.

The Under Secretary Of The Department Of Energy Visits LASL





In the photo above, Morton Kligerman, DIR/ADRT, right, discuss pion therapy programs with Dale D. Myers, Under Secretary of the Department of Energy, as LASL Director Harold Agnew listens. Myers visited LASL briefly on November 9 for general orientation. In the photo at left Myers is given a tour of the L-Division 8-beam system. Assisting with the tour are Joe Ladish, L-1, left, and Jim McNally, L-DO. Myers visited the National Security and Resources Study Center, as well as laser facilities and LAMPF.

The Effort
Is Just
Beginning. . .

Video Learning Center Has Promising Future

A video learning center (call it a classroom with television sets in it, if you prefer) is a place where students get instruction by viewing tv monitors, as well as by looking at the instructor.

But the video learning center (VLC) is much more than a classroom with tv monitors. It is an idea, a concept with a promising future, according to LASL people involved in in-house training for Laboratory employees.

More education and training for employees is a growing, continuing endeavor at LASL. Administrators and supervisors are trying to ensure that their employees have the opportunity to enhance their on-the-job proficiencies, and the most effective way, both in time and dollar savings, is to have an effective in-house training program.

The Laboratory has for years provided training and educational opportunities for staff members and technicians. Rapidly changing technologies have mandated new, improved training techniques to keep technicians and scientists abreast of the developments in their fields.

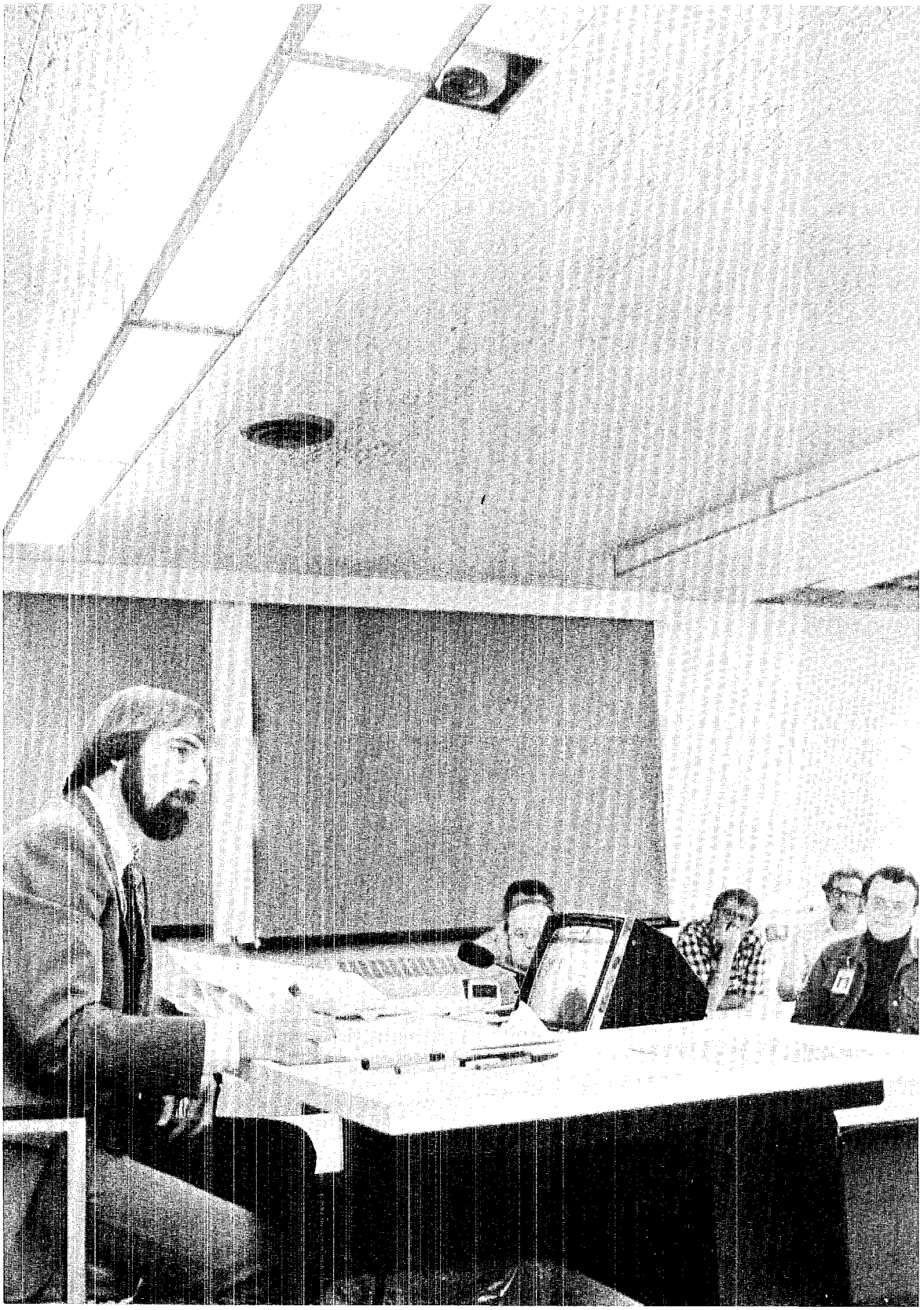
Video-assisted training is helping to meet these demands.

LASL's establishment of a video learning center is tangible evidence of the Laboratory's desire to provide top-quality educational opportunities in the most effective way.

The Laboratory started videotaping classroom instruction in 1976 so personnel who miss sessions can view on videotape what they miss in the classroom.

The effort began by using one mobile camera and a video tape

The instructor has flexibility in use of 2 remote controlled cameras to present written and illustrated material at a desk and blackboard.



Advocates Envision A DOE-wide Educational System Using Satellites To Serve the Needs of Employees

recorder during sessions in Personnel Department training rooms. Two technicians from ISD-9 recorded the sessions as the students watched the instructor. The videotapes were made available to students who had missed classroom sessions, and also were made available to other laboratories and research or educational institutions for use in self study or in proctored videotape courses.

LASL, as part of its continuing education programs, also receives videotapes from other institutions to aid in classroom instruction here.

The new VLC, a classroom which presently accommodates 28 students who view the instructor's efforts with the aid of tv monitors, is a definite improvement over the first videotaping program.

The VLC is arranged so the instructor has a desk and blackboard at the front of the room, with a remotely controlled camera mounted on the room's rear wall, and another remotely controlled camera mounted in the ceiling directly over the instructor's desk.

The students, sitting 2 to a desk and sharing a monitor, see what either or both of the cameras see, plus slides and films that can be shown over the monitor, all simultaneously if desired.

One person sitting in the small control booth in one rear corner of the room can zoom cameras in on the instructor's face, the blackboard, the written instructions and diagrams or demonstrations on top of the instructor's desk. And at the same time the control room operator can merge the camera views, films, and slides electronically while videotaping the classroom presentation.

This system has obvious advantages over the previous system of one camera, controlled by a technician, while another technician manned a videotape recorder. The possibilities are practically endless for presenting an effective, graphically attractive training package to the students.

Howard Lindberg and Martha Brown, both E-DO, in their LASL Mini-Review 77-9, describe the VLC equipment, advantages, and future possibilities. Ray Morrison, PER-5, and Don Morrow, in charge of Shop Department training programs, and Brown and Lindberg, assisted by numerous LASL groups, worked to establish the VLC.

The people involved are careful to point out that the VLC is only a prototype. Experience gained from operating this facility will, it is hoped, be used in building larger, more sophisticated facilities and in overseeing a larger network of video-assisted training activities, both within the Laboratory and between LASL and other institutions such as Sandia Laboratories.

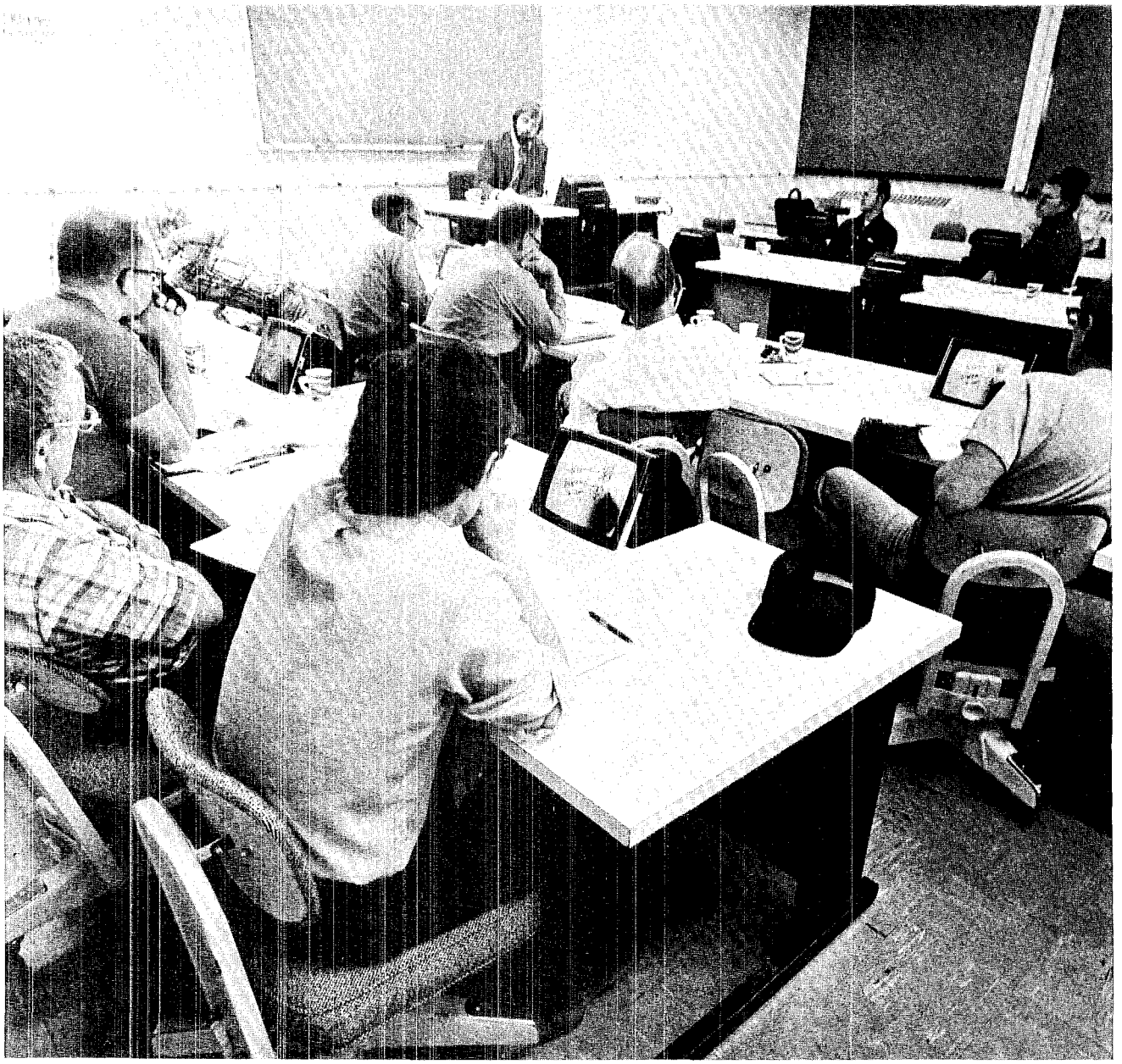
The VLC will provide for experimenting with remote classroom concepts for educational sharing with research laboratories and educational institutions.

One such project is on the drawing board, and it is possible in the future that LASL people will be able to participate in courses being taught and videotaped at Sandia Laboratories in Albuquerque. An experimental real-time TV microwave link would allow transmission of continuing education courses between LASL and Sandia Laboratories.

If the link is established, it will most likely be, at least initially, a one-way microwave link for the transmission of audio and video signals from Sandia classrooms to the LASL VLC. A "talk-back" audio channel from LASL to Sandia would allow the remote LASL students to ask questions and respond to questions from the Sandia instructor.

Such an experiment would be the first step in potential rapid expansion of educational opportunities for LASL employees.

It is possible, report Lindberg and Brown, to envision a DOE-wide educational network using satellite communications to achieve educational sharing among all DOE



Two students share each monitor, on which is shown the instructor, material on the instructor's desk, films or slides, or any combination of the materials.

laboratories. Students at each laboratory's VLC would receive audio and video signals from other installations, and there would be talkback capabilities for students to ask questions and respond to instructional situations.

Advocates of VLC also say that educational cooperation with local and regional institutions of higher education will be facilitated by the existence of video classrooms at various population centers. Availability of such classrooms could vastly aid adult basic education, enrichment programs, and continuing education for people remote from research laboratories such as LASL and Sandia.

LASL's VLC classroom is designed to allow for growth. The system now is monochrome, primarily as an economy measure, except for the video tape recorder and players. Use of full color would be educationally advantageous in the future.

The system, it is believed, has a bright future because of the imagination and creative abilities of the instructors who will use it.

In addition to providing an opportunity for students to make up missed classroom work, the VLC tapes are available for self-study. The self-study aspect is one that LASL hopes will be more fully realized. Talented educators on the staff are usually unable to teach courses repeatedly to meet high demand. Videotapes allow their educational expertise to be made available to many more students than would normally be possible.

Monitors could be placed throughout the Laboratory, and employees could take advantage of a library of educational materials, or perhaps "plug in" to live classroom situations.

The VLC at present cannot schedule and accommodate all of the Laboratory division and department training efforts. Some divisions conduct training courses on their own premises or at other locations, and perhaps some feel they should continue to do so.

But it is hoped that future expansion of the concept of the VLC will allow many more employees to take advantage of top-quality instruction at LASL and in education sharing experiences with other laboratories and institutions.

On the Drawing Board Is A Microwave Link with Sandia Laboratories for Sharing Training Courses

short subjects

RETIREMENTS: **Barbara S. Anderson,** J-10, secretary; **James C. Anderson,** WX-7, staff member; **Elza W. Armstrong,** SP-10, group leader; **Elizabeth V. Coca,** CMB-DO, secretary; **Raymond J. Johnson,** SD-1, laboratory machinist; **Jose S. Martinez,** H-4, animal technician; **George H. Moulton,** CMB-11, staff member; **John B. Panowski,** WX-3, staff member; **Tony Maria Roybal,** CMB-11, special process technician; **Leona M. Spence,** SP-3, clerk; **Lyle A. Wahman,** CMB-8, senior technician; **William J. West, Jr.,** SP-10, senior buyer; **Joseph W. Woolsey, Jr.,** Q-1, senior technician; **Vences Martinez, Jr.,** WX-3, laboratory machinist; **Robert P. Doddridge,** SD-5, laboratory machinist; **Carl A. Enloe,** ENG-4, area coordinator; **Ruth L. Clark,** SP-12, clerk; **Donald W. Kelley,** CMB-11, special process technician.

Robert E. Everhart has been promoted to chief of the Protective Force Section, Security and Fire Protection Branch of the Los Alamos Area Office of the Department of Energy. Everhart has been serving as captain of the Protective Force Section.

D. C. Winburn, L-DO, has been elected to his fifth term as secretary of the Laser Institute of America. The election results were announced at an October meeting of the Institute. Winburn has been employed by LASL for 31 years.

Donald Randolph, ISD-7 micrographic section leader, was elected chairman of the executive committee of the Department of Energy/Contractors Micrographic Association at the association's 5th annual conference in October. The association is a non profit organization that promotes the interchange of micrographic information and overall advancement of applications, techniques, equipment, and design concepts.

Photo Short

A lot of dirt is being pushed around at Ten Site to begin construction of the high energy gas laser facility (HEGLF). The $55-million dollar facility, named Antares, will greatly expand LASL's energy by laser research efforts.

LAMPF Users Group Conducts 11th Meeting

About 250 persons attended the 11th annual meeting of the Users Group of the Clinton P. Anderson Los Alamos Meson Physics Facility (LAMPF) in mid-November at LASL.

The LAMPF Users Group, formed in 1969 and incorporated in 1972, has about 1,000 members representing more than 300 institutions such as universities, hospitals, medical centers, industrial and government laboratories, private industry, and 75 international research facilities. The group provides exchange of information between the scientific community at large and the LASL administration.

Richard Taschek, associate director for research at LASL, welcomed the group on November 14, and Louis Rosen, director of LAMPF, delivered a status report on the meson facility. Presiding over this year's conference was Harvey B. Willard, Case Western Reserve University.

Working sessions, numerous lectures, and talks on various aspects of medium energy physics filled the 3-day conference.

Louis Rosen, director of LAMPF, welcomes members of the Users Group of LAMPF to the 11th annual meeting, attended by about 250 persons.

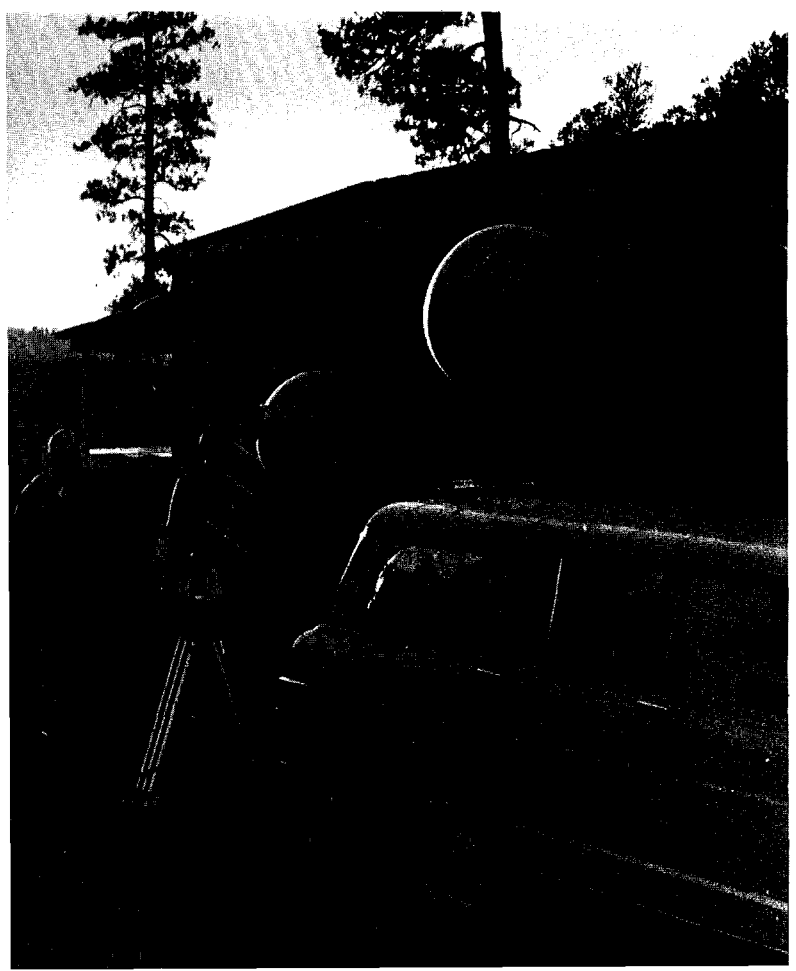
Sky Hook Is Used In Shock Wave Tests

Personnel in Group M-6 lofted a 38-foot-diameter helium-filled ballon 800 feet over Ancho Canyon several weeks ago to aid in a series of tests, one of which has to do with the effect of air shock waves on structures.

The balloon, furnished and launched by experts from the United States Air Force Geophysics Laboratory at Holloman Air Force Base, Alamogordo, was used as a "sky hook" tethered at about 800 feet above the floor of the canyon, and frame structures several hundred feet tall were suspended from it.

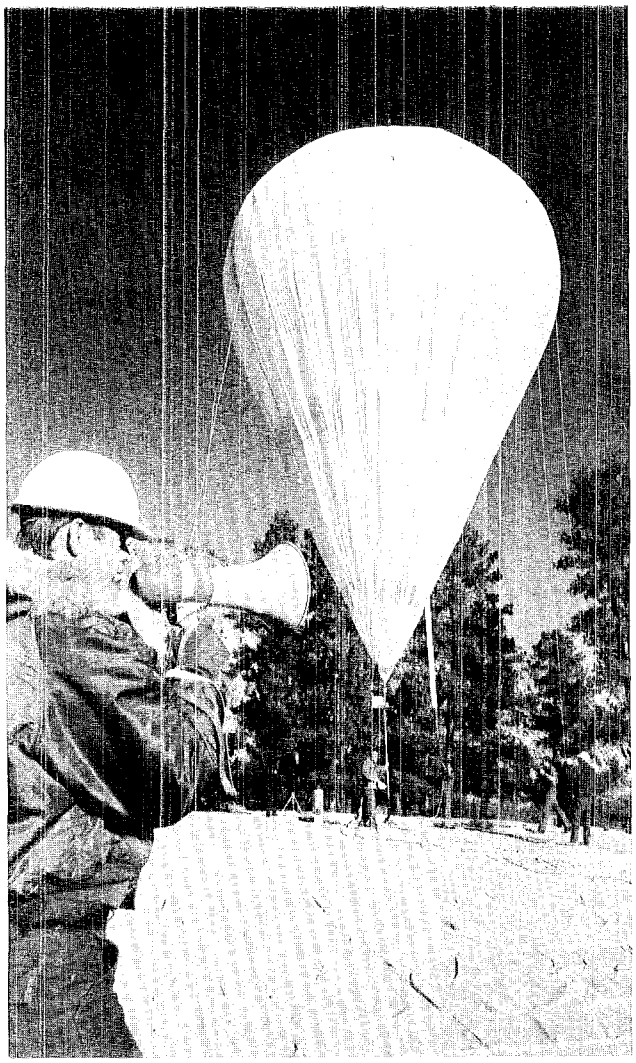
Sponsored by the Naval Surface Weapons Center, Dahlgren, Va., the tests lasted several days.

H - Division people prepare some weather balloons for launch as the sky hook balloon is being readied.

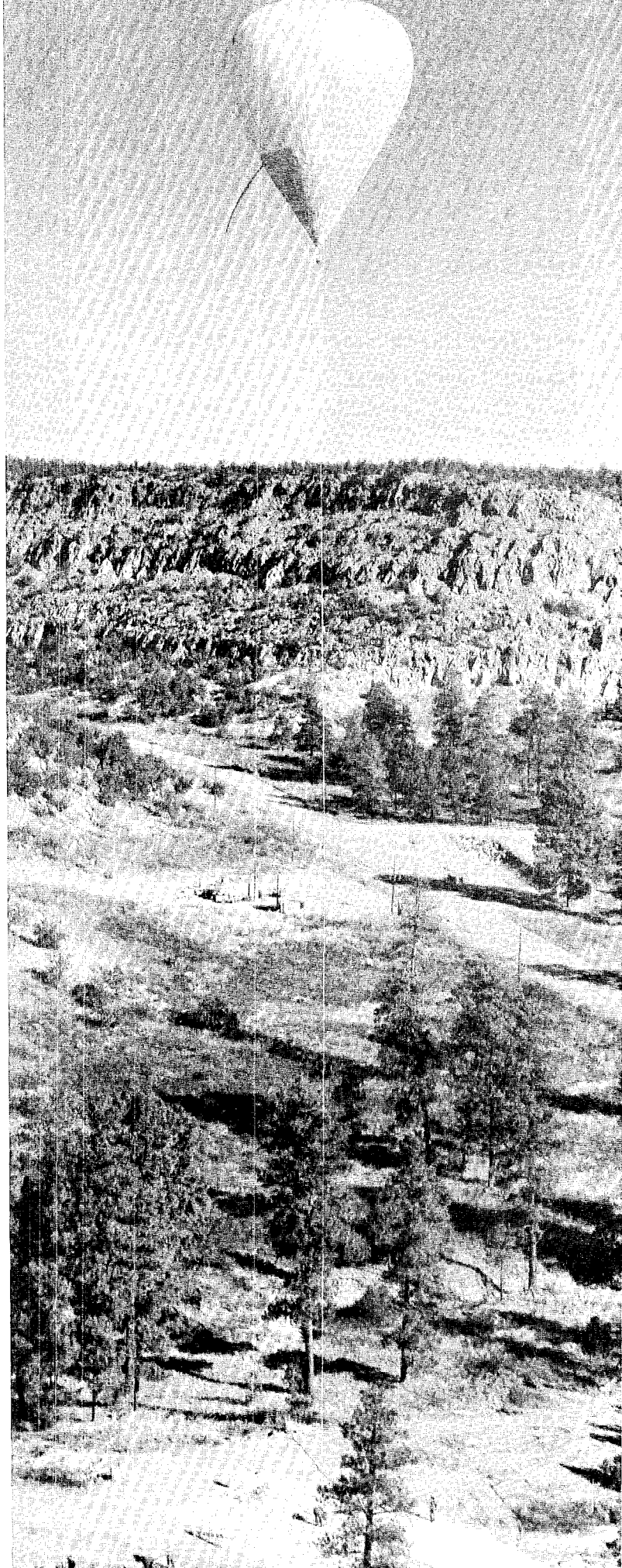


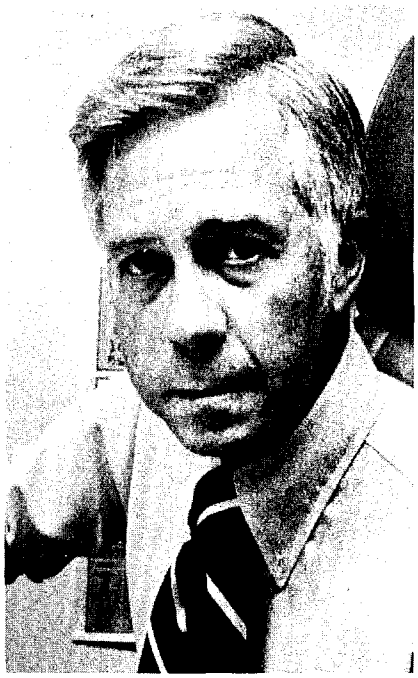
The 38-foot-diameter balloon is filled with helium.

An Air Force specialist gives instructions before the balloon is launched.



The balloon begins its controlled ascent to 800 feet above the floor of Ancho Canyon.





Riechman Earns National Award

Norman H. Riechman, alternate property manager of SP-2, has been named National Property Person of the Year by the National Property Management Association (NPMA).

The award, the first of its kind awarded by the NPMA, was presented to Riechman "in recognition of superior performance through individual effort and technical excellence reflecting outstanding achievement in the field of property." Reichman was 1 of 5 nominees for the award, which was presented at the NPMA's national seminar in Dallas recently.

In addition to the national award, Riechman was elected Northern New Mexico Chapter National Property Person of the Year this summer.

Riechman has worked with LASL's supply and property department for 27 years.

10 years ago in los alamos

Culled from the December, 1967 Files of The Atom and the Los Alamos Monitor by Robert Y. Porton

PUBLICATION

Henry Laquer, CMF-9, is the author of a new booklet, "Cyrogenics, the Uncommon Cold," just published by the Division of Technical Information of the United States Atomic Energy Commission. The booklet issued this month, is the newest in the AEC series on "Understanding the Atom;" printed in Oak Ridge, Tenn., for distribution to the general public.

UP IN THE AIR!

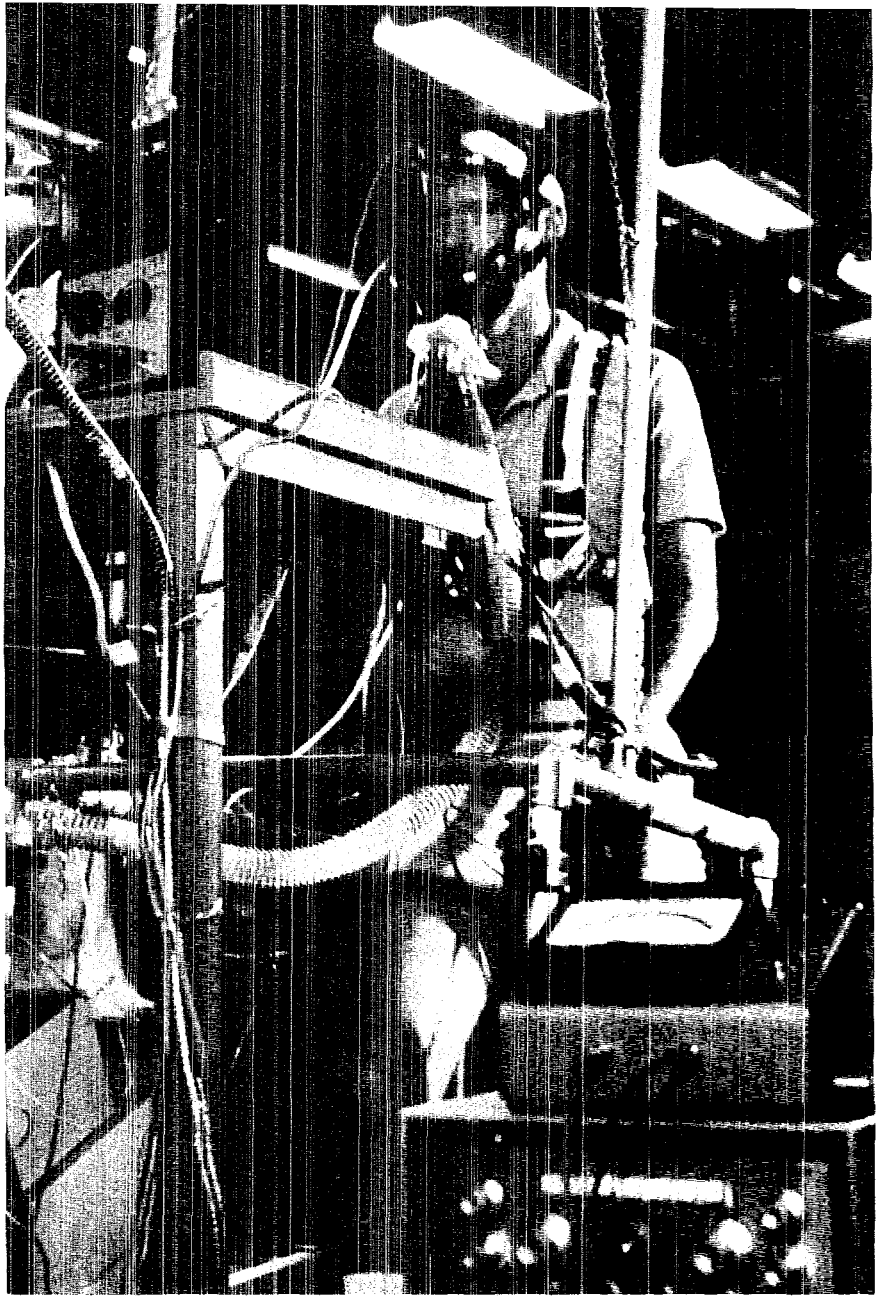
Nine men from the Los Alamos Scientific Laboratory just returned from a 2-week tour of duty conducting studies from LASL's airborne laboratory, an NC-135 jet aircraft flying over Alaska and the Yukon Territory. Three subjects were included in the studies—the aurora borealis, cosmic rays, and the earth's surface. The men made detailed studies of certain emission lines from the aurora, and throughout the mission they monitored the cosmic ray background. Among those taking part in the project were Robert Peterson, Lucien Black, Leston Miller, Dick Tatro, Richard Wakefield, Joseph Hollinrake, Dan Stillman and Walter Wolff.

RECORD SNOW!

Los Alamos residents appear to have seen the end of the biggest snow storm ever to hit the Hill City. Some 37.6 inches of the white stuff have been dumped on Los Alamos in the past week. This, taken with the one inch that fell earlier in the month, is a record snowfall for the month of December.

C. D. EXERCISE

More than 120 Los Alamos Civil Defense volunteers took part in a special shelter management course that took place here this week. The course was under the direction of the University of New Mexico CD University Extension Department. The purpose of the exercise is to train shelter management staffs to carry out their shelter responsibilities and duties. On Friday, the trainees, including several scout troops, spent 8 hours in the HRL fallout shelter. All information, instructions and special "problems" were transmitted by Civil Defense radios and telephone giving an atmosphere of realism during the time of shelter occupancy.



Lt. Randy Odel, a U.S. Air Force test volunteer, walks a treadmill at Brooks Air Force Base in San Antonio, Texas, to determine the volume of exhaled air and the exact concentration of carbon dioxide and oxygen in his exhaled air. The tests at the Air Force base are part of a joint effort to measure the effectiveness and safety of breathing equipment used by the military and industry. LASL's Group H-5 is conducting research into the design of respirators and self-contained breathing apparatus, and the Air Force's School of Aerospace Medicine is determining physiological effects of using these types of respirators. Tom Davis headed H-5's effort during the tests in San Antonio recently. He said the information gained from the tests at Brooks Air Force Base, and the results from numerous LASL tests on design and safety of respirators, will lead to a good definition of how respirators affect those who have to wear them. This information will be turned over to the federal government in the next few months. (Photo courtesy of the U. S. Air Force)

MØTZ HENRY THØMAS
3187 WØØDLAND RD
LØS ALAMØS NM
87544

What appears to be mist floating over the surface of a pond in some marsh or swamp actually is steam flowing from a pipe in LASL's hot dry rock steam-producing system at Fenton Hill.